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(21) International Application Number: PCT/US99/02014 (22) International Filing Date: 29 January 1999 (29.01.99) (30) Priority Data: 60/073,375 2 February 1998 (02.02.98) US (63) Related by Continuation (CON) or Continuation-in-Part (CIP) to Earlier Application US 60/073,375 (CON) Filed on 2 February 1998 (02.02.98) (71) Applicants (for all designated States except US): BRISTOL AEROSPACE LIMITED [CA/CA]; 660 Berry Street, P.O. Box 874, Winnipeg, Manitoba R3C 2S4 (CA). DAY-TON-GRANGER INC. [US/US]; 3299 S.W. 9th Avenue, Ft. Lauderdale, FL 33315 (US). (72) Inventors; and (75) Inventors/Applicants (for US only): CLINE, Jay, D. [US/US]; 2605 Castilla Isle, Fort Lauderdale, FL 33301 (US). CHAN, Nelson [CA/CA]; 40 Providence Road, Winnipeg, Manitoba R3T 4G8 (CA).		(74) Agent: HUNT, Ross, F., Jr.; Larson & Taylor, Transpotomac Plaza, Suite 900, 1199 North Fairfax Street, Alexandria, VA 22314-1437 (US). (81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>Without international search report and to be republished upon receipt of that report.</i>
(54) Title: WIRE STRIKE PROTECTION SYSTEM WITH INTEGRATED ANTENNA (57) Abstract A combined wire strike protector and antenna device is mounted on an aircraft in the optimal location for an antenna and at the required position for the wire strike protector. The device includes a wire cutter having a forwardly open throat and a deflector plate projecting upwardly from the cutter for deflecting wires into the throat. The antenna component is a slot antenna including a conductive plate extending rearwardly from the deflector and a slot in the plate. The slot is dielectrically loaded with a material selected to optimize the impedance of the slot for the frequencies for which the antenna is designed. A coaxial choke is used to keep the radio frequency (RF) energy off the coaxial antenna feed line.		

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WIRE STRIKE PROTECTION SYSTEM WITH INTEGRATED ANTENNA**FIELD OF THE INVENTION**

The present invention relates to wire strike protection devices of the type used on aircraft, especially helicopters.

BACKGROUND

A cable cutting wire strike protector is disclosed in United States patent 4,215,833, issued 5 August 1980, the disclosure of which is incorporated herein by reference. This device is mounted on the forward part of an aircraft. The device includes a wire cutter with a forwardly open throat and a deflector plate projecting upwardly from the cutter. A leading edge of the deflector slopes upwardly to the front from the cutter for deflecting wires into the cutter throat.

In use, these protectors are mounted on a helicopter in the position that is optimal for the installation of an antenna, making it necessary to select another less than optimal position for the antenna.

The present invention is concerned with the modification of the wire strike protector to incorporate an antenna.

SUMMARY

According to the present invention there is provided a combined wire strike protector and antenna device comprising:

- a base for mounting the device on an aircraft;
- a wire cutter mounted on the base, the cutter having a forwardly open throat;
- a deflector comprising a plate projecting upwardly from the cutter and having a leading edge sloping upwardly to the front from the cutter for deflecting wires into the throat of the cutter; and
- an antenna comprising a conductive plate extending rearwardly from the deflector and a slot in the conductive plate.

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The preferred embodiments have a slot antenna formed into an integral rearwards extension of the deflector. This extension is a vertically oriented plate projecting horizontally from the top of the back edge of the deflector. A horizontal slot is formed in the extension to provide the slot antenna.

A conventional slot antenna requires choking slots at one quarter wave lengths above and below the main slot, undesirably increasing the necessary size of the antenna for this application. The conventional antenna has a radiation pattern with a nulls at the ends of the slot. These disadvantages of the conventional antenna may be overcome in embodiments of the invention by dielectrically loading the slot and adjusting the ground plane for optimum radiation patterns. The material used to dielectrically load the slot is chosen to optimize the impedance of the slot for the frequencies for which the antenna is designed. A coaxial choke is used to keep the radio frequency (RF) energy off the coaxial antenna feed line.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings, which illustrate one exemplary embodiment of the invention:

Figure 1 is a side view of a device constructed according to the present invention;

Figure 2 is a side view, with the side cover removed, of the device of Figure 1;

Figure 3 is a cross section along line 3 - 3 of Figure 2, omitting the antenna lead wires and the choke coil;

Figure 4 illustrates the mounting of the device on a helicopter; and

Figure 5 is a detail of a coupler used in the assembly of Figure 4.

DETAILED DESCRIPTION

Referring to the accompanying drawings, there is illustrated a

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combined wire strike protection and antenna device 10. The device has a mounting base 12 for mounting the device on the body of a helicopter. A cable or wire cutter 14 is mounted on the base. The cutter has two wire cutting edges 16 that converge to the rear from an open throat 17 for cutting forced between them. A deflector 18 projects upwardly from the cutter. The deflector is a plate with a leading edge 20 that slopes upwardly to the front from the cutter for deflecting wires and cables into the throat 17 of the cutter. This structure has a configuration and function generally like that of the device described in United States patent 4,215,833, referred to above.

The device 10 also incorporates an antenna 22. This includes a conductive plate 24 that projects from the rear of the deflector, at the top of the deflector. In this embodiment, the plate 24 is an integral rearwards extension of the deflector plate. The plate 24 has a straight top edge 26 aligned with the top end of the deflector 18. The bottom edge 28 of the antenna is straight and parallel to the top edge 26 at the rear. At the front it merges into the rear edge of the deflector through a large radius curve 30.

An antenna slot 32 extends along the plate 24, parallel to and between the edges 26 and 28. The slot has a semicircular front end 34 and a straight back end 36 perpendicular to the top and bottom edges of the slot. The slot is filled with a dielectric loading material 38 selected to provide the optimal impedance for the frequencies for which the antenna is designed. On opposite sides of the slot, the plate has recesses 40 and 42 serving as slot feed points. An antenna lead 44 extends from the upper recess 40 through a passage 46 in the dielectric 38 to the lower recess 42. Lead 44, and a second antenna lead 48, extends from the lower recess 42 to a circular counterbore 50 in the plate 24 immediately in front of the curved rear edge 30 where they are connected to a coaxial cable choke 52. The coaxial feed wire 54 for the antenna extends from the

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choke along a slot 56 in one side of the deflector plate 18, adjacent its rear edge.

On the left side of the plate 24, as shown in Figures 1 and 2, is a shallow recess 58 that extends along both sides of the slot, around the front end 34 and the counterbore 50, and in a narrow strip down the back side of the deflector 18, along the slot 56. A similar recess 60 (Figure 3) is provided on the right side of the plate 24 extending along the slot but not down the back of the deflector. The recesses 58 and 60 accommodate fibreglass shells 62 and 64 respectively (Figure 3) which enclose opposite sides of the antenna. Where the wire 54 extends down the back of the cutter 14, it is covered by a fibreglass cap 66.

Figures 4 and 5 illustrate the mounting of the cutter and antenna device on a Sikorsky Blackhawk helicopter 68. For this helicopter the cutter - antenna is mounted on a forward sliding canopy 70 in front of the main rotor. The canopy can slide approximately six feet to allow maintenance personnel access. A coupler and bracket arrangement is used to avoid the use of a coaxial feed line with enough slack to compensate for this movement.

A broadband matching coupler 72 is mounted on the inside of the sliding canopy by a mount 74. This coupler houses the broadband matching network for the antenna. It is connected to the feed line 54 by a TNC connector 76. A connector guide pin 78 projects from the back end of the coupler 72. A support bracket 80 is mounted on the fixed surface of the helicopter opposite the coupler. The bracket has a socket 82 for receiving the guide pin 78 and guiding a blind mating connector of the coupling into engagement with a cable jack on the bracket. The jack is spring loaded to exert an extra force for maintaining the connection once the coupler is engaged.

The device of the invention resolves the conflict between mounting a wire strike protector where it is required and an antenna, which is optimally placed

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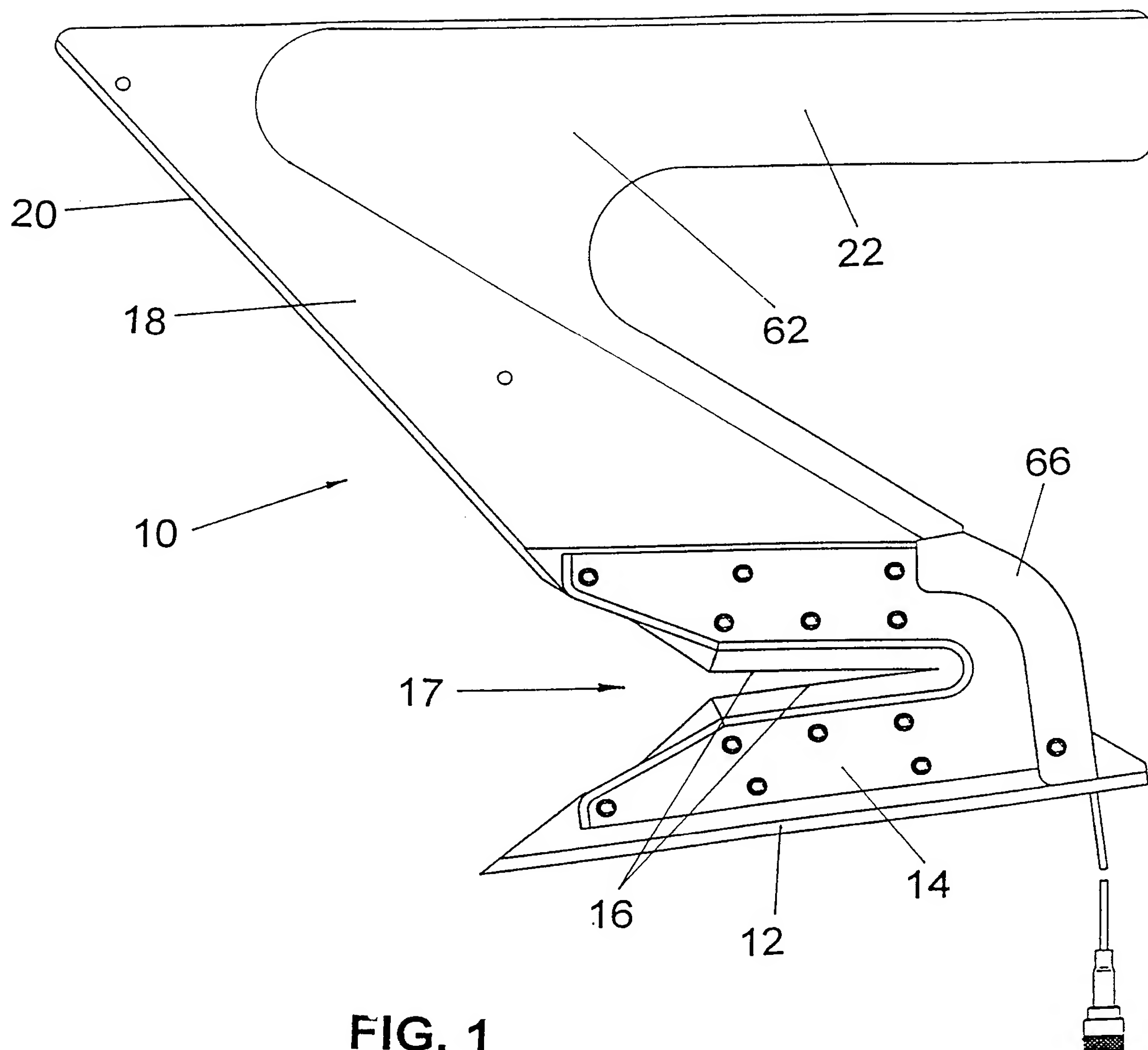
at the same location. With the invention, both objectives can be met with a single device.

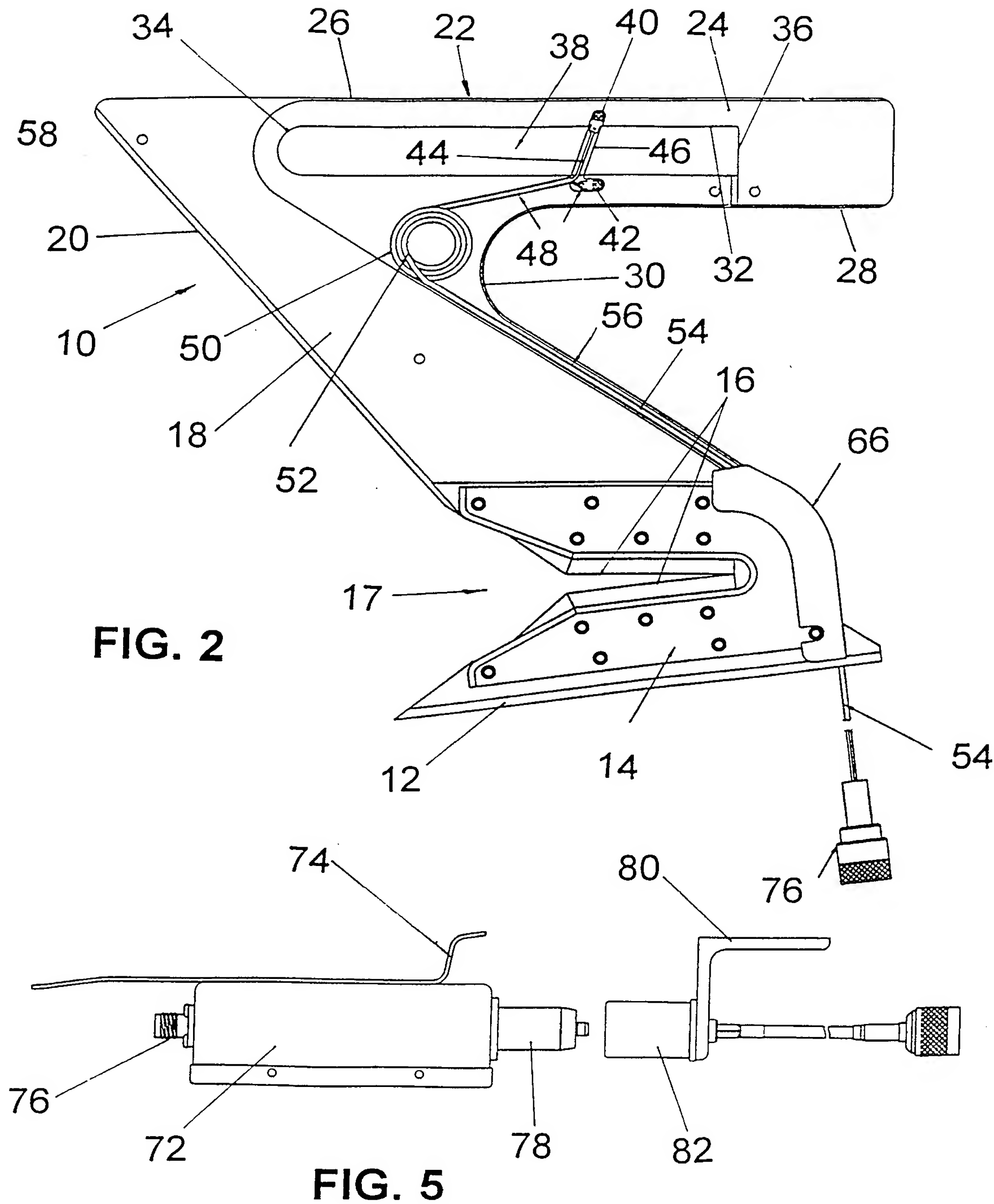
While one specific embodiment of this invention has been described in the foregoing, it is to be understood that the invention is not limited to that embodiment. The invention can be applied to any helicopter and any helicopter wire cutter. It may be designed to cover any frequency band with a slot type antenna or any other type of radiating element antenna with minor modifications that are within the abilities of those knowledgeable in the art.

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CLAIMS

1. A combined wire strike protector and antenna device comprising:
 - a base for mounting the device on an aircraft;
 - a wire cutter mounted on the base, the cutter having a forwardly open throat;
 - a deflector comprising a plate projecting upwardly from the cutter and having a leading edge sloping upwardly to the front from the cutter for deflecting wires into the throat of the cutter; and
 - an antenna comprising a radiating element carried by the deflector.
2. A device according to Claim 1 wherein the antenna comprises a conductive plate extending rearwardly from the deflector and a slot in the conductive plate.
3. A device according to Claim 2 wherein the conductive plate is an integral rearwards extension of the deflector.
4. A device according to Claim 3 wherein the conductive plate projects horizontally from the top of the deflector.
5. A device according to Claim 3 or 4 wherein the slot is a horizontal slot in the extension.
6. A device according to any one of Claims 2 to 5 including a dielectric material filling the slot.
7. A device according to any one of Claims 1 to 6 including a coaxial antenna feed line including a coaxial choke mounted on the deflector.





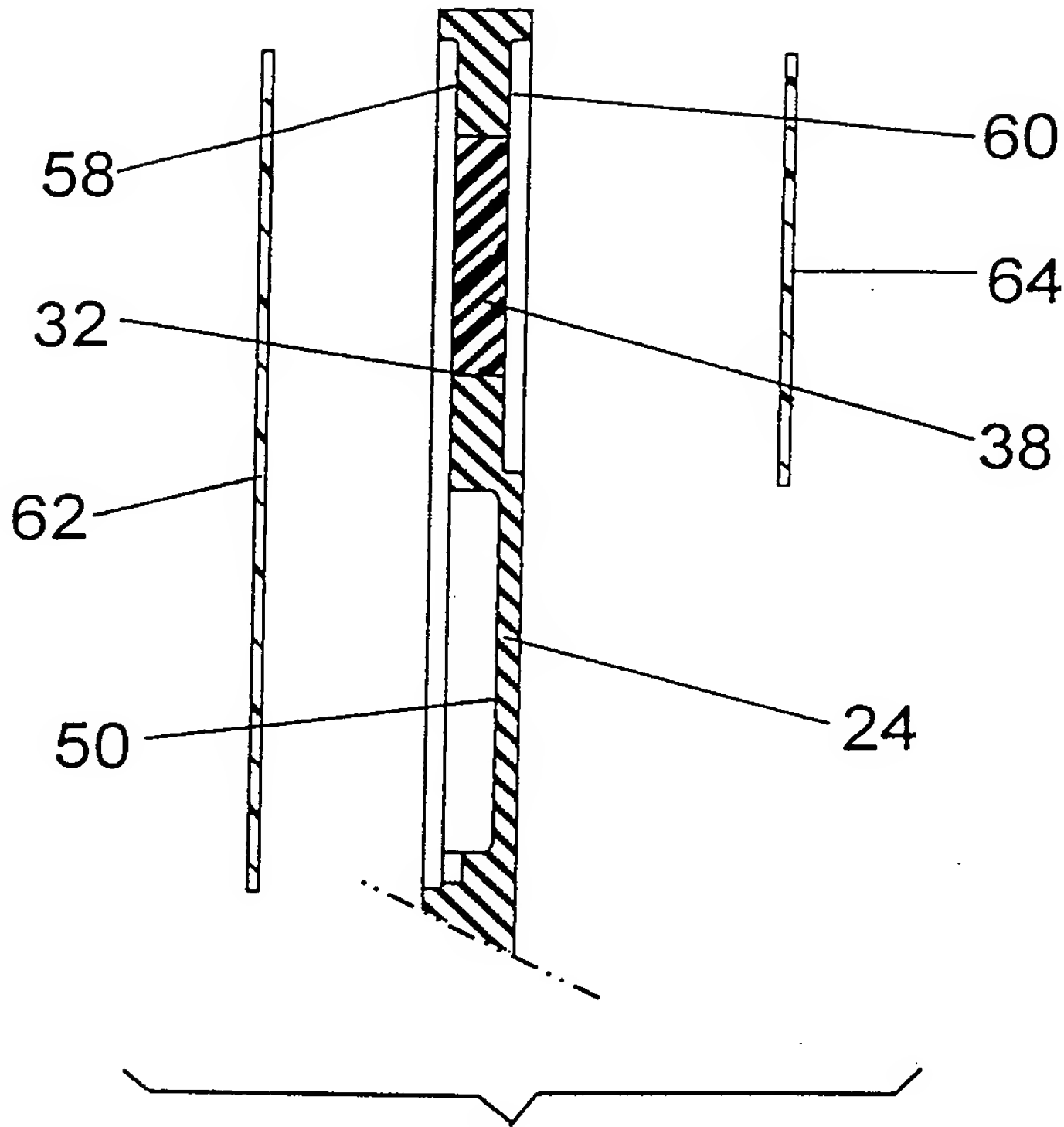


FIG. 3

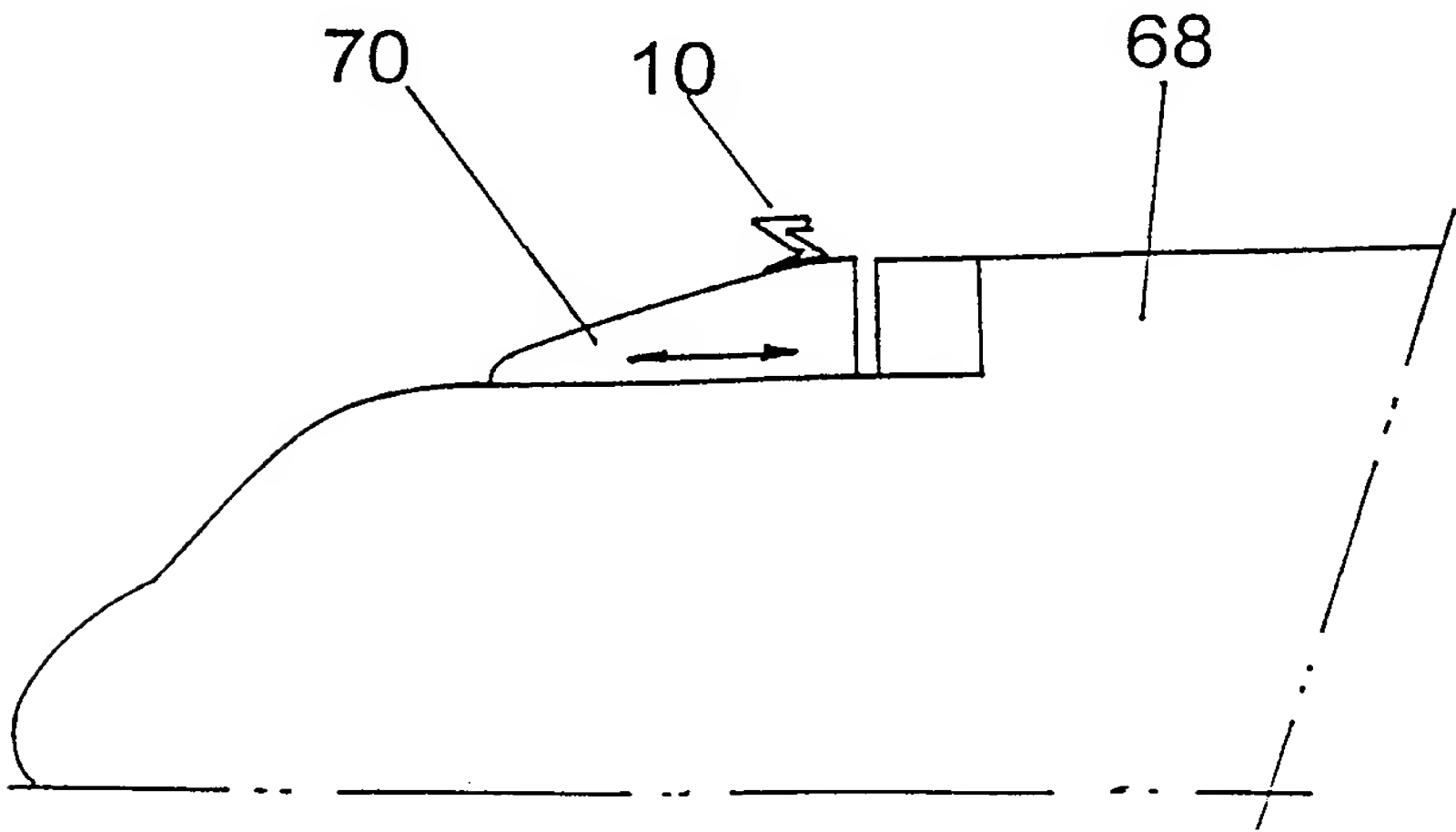


FIG. 4